MEMS microphone mechanical & acoustical implementation

About this document

Scope and purpose

This document provides information on the mechanical and acoustical implementation of MEMS microphones

Intended audience

Infineon XENSIV^{TM} MEMS microphone customers

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1 Abstract

This application note gives guidelines for device designers on optimizing the acoustical and mechanical implementations of MEMS microphones. Perfecting the implementation maximizes the performance of the microphone system and enables stable and disturbance free high-performance operation and high reliability.

2 Acoustical implementation

2.1 Microphone acoustic channel design

A microphone needs an acoustic channel from the sound port on (or under) its package to the surface of the device

- The length, diameter and shape of the channel determine its acoustic properties
- Also the acoustic properties of the microphone affect the overall system performance
- Other key factors are acoustic sealing and stability of the channel

The device sound channel consists typically of…

- The sound port (1), front volume (the volume of air between the sound port and the membrane) (2) and membrane (3) of the microphone
- Hard plastic or metal mechanical parts of the device (e.g. device housing with a sound port (4))
- Sealing gaskets (5) or boots that connect the channel between the rigid parts (for example, between the microphone package and the device housing as seen in the drawing on the right)

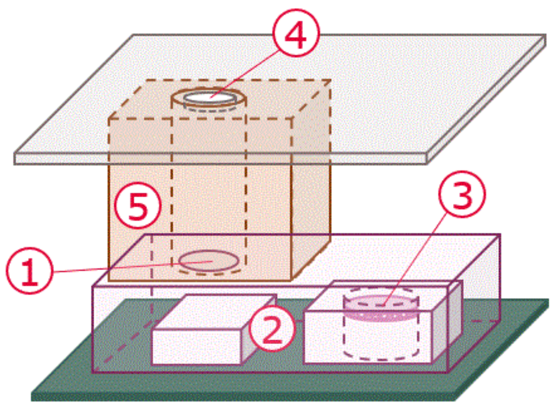

Figure 1 Microphone acoustic channel design

2.2 Frequency response of a microphone in a device

The frequency response of a microphone in a device depends on several factors:

1. **The acoustics and frequency response of the microphone**
    - Even on a bare microphone component, the sound port and front volume can easily form a Helmholtz resonator that is likely to limit the usable acoustic bandwidth
        - A Helmholtz resonator should be avoided by optimizing microphone properties so that the performance of the microphone implementation is maximized
    - Minimizing the front volume has significant benefits for the microphone
        - Helmholtz resonance is eliminated or moved to a higher frequency. Improved frequency response improves microphone system performance especially if the design of the device sound channel is compromised (for example, contains one or more cavities)
    - Typically, a Helmholtz resonance moves to a lower frequency when the microphone is implemented into a device
        - The additional acoustic porting introduces more tubes and/or cavities to the acoustic system
        - In order to optimize the performance of the microphone implementation, the device sound channel must be carefully designed to affect the performance negatively as little as possible
    - Different microphones will behave differently in the same device acoustic channel
        - The shape and size of the acoustic channel in the microphone affect the behavior
        - The role of the size of the front volume of the microphone is especially critical when the microphone is implemented into a device; the volume should be minimized
        - The size of the sound port of the microphone should big enough not to act as a significant constriction in the overall sound channel
2. **The acoustic channel built into the device mechanics**
    - In order to move the resonance frequency (the Helmholtz resonance) of the acoustic system to a higher frequency and to reduce the height of the resonance, the acoustic channel should be short, wide and uniform.
        - A rule of thumb is that the length should be less than twice the diameter
    - The cross-sectional area should be uniform throughout the channel
        - Cavities and constrictions should be avoided (see ***Figure 2***)
        - Common reasons for wider parts (cavities) in the channel are sealing gaskets whose holes are bigger than the holes in the rigid sealed structures
    - The size of the acoustic port on the *device* housing should be as big as possible to improve frequency response
        - Also, the housing (cover) thickness should be minimized
    - The sound channel design should be simulated in order to optimize it and to avoid unnecessary prototyping rounds that cost time and money

Figure 2 Sound channel shapes

3. **Acoustic materials such as dust or water proofing meshes and membranes** in the sound channel affect the frequency response
   - Meshes can dampen resonance peaks so they can, in some cases, be used to improve the frequency response
4. **Acoustic leaks** in the channel affect the frequency response especially at low frequencies
   - Acoustic sealing will be discussed in more detail later in this application note
5. **The body of the device itself can affect the frequency response** significantly
   - If the microphone is built into an enclosure (for example, device housing), the housing can affect the propagation of the sound waves significantly if the housing size is similar to the wavelength of the captured sound
   - For example, a substantial surface area (dimensions similar or longer than the wavelength of the sound) around the sound port can boost some frequencies
     - High frequencies (short wavelength) can be significantly boosted
     - An 8-cm housing may have a significant boosting effect on frequencies at 4kHz and higher
       - For reference, 8cm is roughly the width of a normal smartphone or the diameter of a 1st generation Amazon Echo
     - The traditional voice band (frequency $f < 4kHz \rightarrow$ wavelength $\lambda > 8.6cm$) is not very likely to be affected by handheld-sized devices
   - The location of the sound port on the surface of the device can play a significant role
     - Close to an edge or a corner is typically better than in the middle of a large flat surface
6. Also, other **objects or surfaces close to the device** can affect the frequency response

A compromised frequency response can be improved electrically with filtering or equalization. However, this can affect phase performance of the microphone system negatively.

Note: The device sound channel should be short, wide and uniform. The length should be less than twice the diameter. Cavities and constrictions should be avoided in the channel.

2.3 Microphone package types

As was discussed in the **Chapter 2.2** section, the front volume of the microphone should be minimized to optimize the acoustic channel from the surface of the device to the MEMS membrane. The acoustic structure of a bottom port microphone is typically close to ideal in this regard: the front volume is small and the back volume is big. (Increasing the back volume size improves the sensitivity, SNR and frequency response of the microphone.) The microphone is acoustically sealed against the circuit board with a sealing ring around the sound port on the bottom of the microphone (1), which is soldered against a similar ring on the circuit board. Further sealing elements (2) are needed on the other side of the circuit board. In the simplest case, the device cover (3) is close and parallel to the circuit board; a sealing gasket (2) connects the hole in the circuit board to the hole in the cover (4).

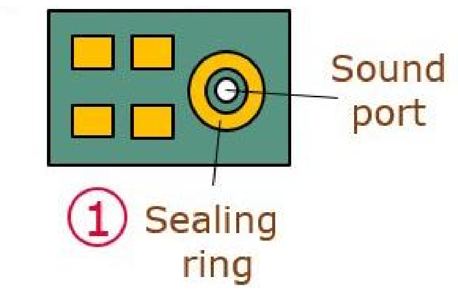

Figure 3 Bottom view - bottom port microphone

If the MEMS sensor of a top port microphone is mounted on the lid of the microphone package (see ***Figure 4***), the acoustical characteristics are similar to those of bottom port microphones: large back volume, small front volume. A traditional style top port microphone where the MEMS sensor is mounted on the microphone package substrate is a compromised design due to the large front volume and small back volume. The sound channel is sealed against the microphone sound port on top of the package. In the simplest case, the device cover (5) is close and parallel to the top of the microphone; a sealing gasket (6) connects the microphone sound port to the hole in the cover (7).

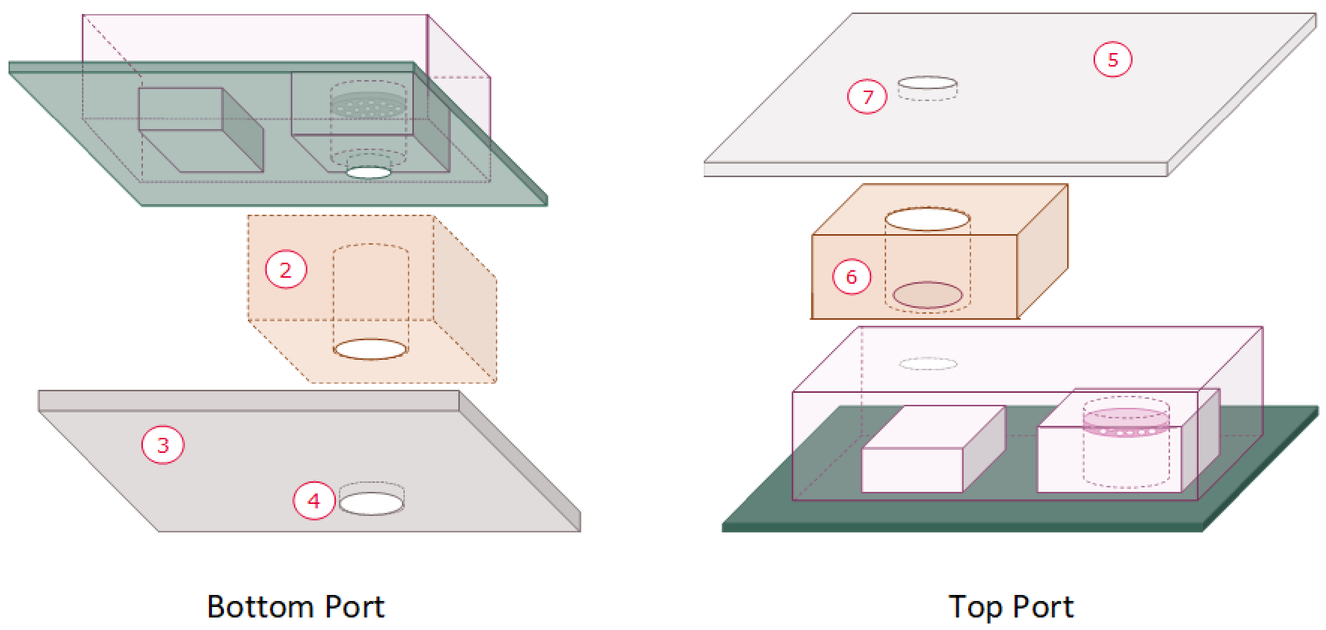

Figure 4 MEMS microphone package type

Note: The choice of microphone package (top or bottom port) depends on the structure of the device; the goal should be to minimize the length of the sound channel in the device and to make it as uniform and simple as possible.

2.4 Ultrasound

The acoustic structures of the sound sensors in many MEMS microphones enable capturing ultrasound, i.e. frequencies above 20kHz. The resonance of the MEMS sensor (membrane) is typically at a very high frequency (tens of kHz). However, it is often difficult to achieve a flat frequency response up to the ultrasonic frequencies when the acoustic sensor is built into a microphone package and the package is built into a device.

Often, a MEMS microphone system has two acoustic resonances. The 1st one is caused by the front-end acoustics of the MEMS microphone (sound port, front volume, membrane) as well as the device sound channel. The 2nd one is caused by acoustics behind the microphone membrane (backplate, back volume).

Achieving a flat frequency response from the low audible frequencies up to above 20kHz is challenging

- In applications where the same microphone is meant to capture both audible frequencies as well as ultrasound, this can lead to compromised performance at one or both of those frequency bands
- Typically, the 1st resonance occurs at mid or high audible frequencies (between 10kHz and 20kHz) or at low ultrasonic frequencies (between 20kHz and 25kHz)
- In some cases, the 1st resonance can be designed to lie at high audio frequencies or at a suitable frequency above the audible frequency range (for example, somewhere between 15kHz and 25kHz) but below the ultrasonic frequency band that the system is meant to capture
  - This way the resonance disturbs the capturing performance the least
- The 2nd resonance is often at a very high frequency where is does not affect the frequencies that the system is meant to capture
  - This should be verified by simulating or testing
- For the best results at very high frequencies (>30kHz), the sound channel should be wide and short, with no constrictions that would cause resonances

3 Mechanical implementation

It is not enough that just the acoustical design of a microphone in a device is well executed. Also, the mechanical implementation of a microphone into a device plays a key role in optimizing the quality and reliability of the capturing system.

Proper mechanical design of the device ensures the microphone

- A proper acoustical environment
  - Optimized and invariable acoustic dimensions and reliable acoustic sealing
- Protection from external factors such as weather
  - For example, dust and/or water protection can be implemented into the sound channel
- Protection from mechanical factors
  - Mechanical stresses in the device (deformations, compression)
  - Abuse such as bumps or poking
  - Pressure shocks
- Optimized size of the implementation
  - The size of a microphone alone does not determine the volume needed in the device; also, the whole implementation including, for example, sealing solutions, keep-out-zones, and supporting structures must be taken into account
- Correct location to optimize microphone system performance
  - Locations of the microphones close to the surface of the device to enable short acoustic ports
  - Microphone locations designed to optimize the capturing performance of the microphone system

3.1 Examples of mechanical design features

1. Optimized acoustic dimensions
   - Hole shapes, lengths and cross-sectional areas
2. Properly designed acoustic sealing
   - Correct acoustic dimensions
   - Correct thickness and compliance
   - See details in the 'Acoustic Sealing' section
3. A ridge (or other such feature) can be added onto the device cover to fix the sealing gasket in place and prevent movement in the X/Y-plane
   - This stabilizes the acoustic dimensions and sealing
4. Supporting screw towers (or other supporting features) close to microphones prevent movement in all directions (X/Y/Z)
   - This stabilizes the acoustic dimensions and sealing as well as prevents circuit board deformations (in Z-direction)
   - Features that support the microphone and the circuit board are especially important when the microphone is mounted on a flexible circuit board.
5. Dust / liquid protection mesh / membrane
6. Supporting structures under the circuit board to prevent circuit board deformations

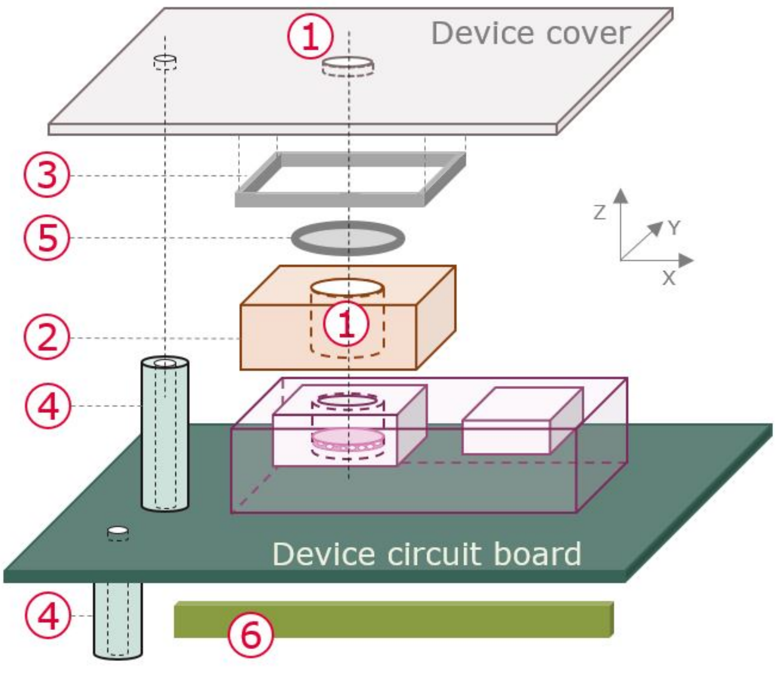

Figure 5 MEMS microphone mechanical design

3.2 Size

There are a handful of standard MEMS microphone sizes available in the market. Common sizes are, for example, 4.0x3.0x1.0mm (digital microphones), 3.5x2.65x0.98mm and 3.35x2.5x0.98mm. Non-standard sizes exist for, for example, very high-performance microphones (e.g. 4.0x3.0x1.2mm) and very small components.

In many device types, it is a crucial success factor to minimize device size. Size is critical for, for example, wearables such as smartwatches. The most important dimension to be minimized depends on the device. For a smartwatch, minimization of the overall volume is likely the key goal. In a tablet or laptop, minimized width of the microphone implementation may be the key target. It may, for example, enable minimizing the length of a sound channel that runs to the edge of a display bezel if drilling a hole for the sound channel through the display glass should be avoided.

The right choice of component for a device depends on the device mechanics. This may determine, for example, whether a top port or bottom port microphone enables achieving a smaller implementation size. The smallest component doesn't necessarily yield the smallest implementation size. For example, small top port components have only small sealing areas on top of them around the sound port. In addition to that, sealing gasket location tolerances may not be very accurate. Therefore, very small top port microphones may have to be sealed *around* the component instead of *on top of* the microphone causing the implementation size to be the same or even bigger as compared to a significantly bigger microphone.

The illustrations below show an example of a 4.0x3.0mm footprint microphone with a gasket on top vs. a 3.0x1.8mm microphone with a boot around it. Note that the implementation footprint for the smaller microphone is bigger.

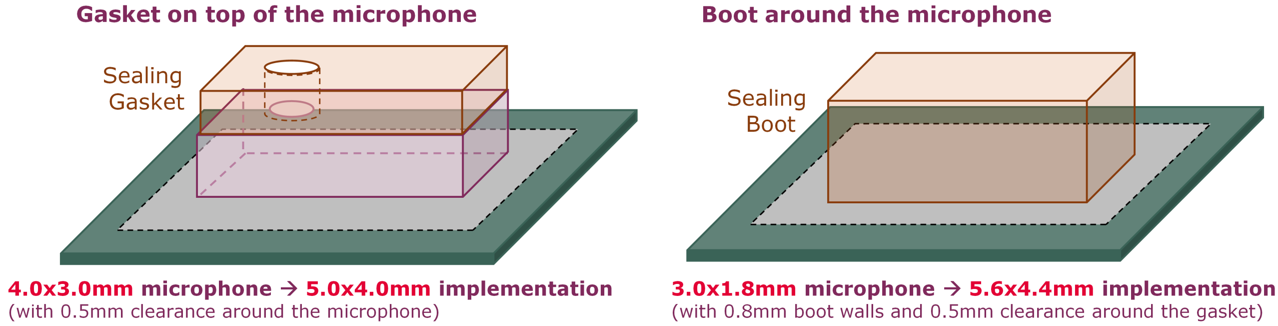

Figure 6 MEMS microphone mechanical size implementation

Note: The smallest microphone component doesn't necessarily yield the smallest implementation size.

3.3 Acoustic sealing

In order to optimize the quality and reliability of a microphone system, the sound channels for the microphones must be sealed (except, naturally, for the two ends at the microphone and at the surface of the device). The way sealing is executed affects the acoustic properties of the microphone system so careful design work and verification are required. The dimensions and shapes of the holes in the sealing elements as well as sealing element materials must be designed so that performance is optimized (without forgetting system reliability). The guidelines for the acoustic design of the sound channel (see section ***Chapter 2.2***) must be followed when designing the channel and the sealing elements.

'Sealing' means sealing hermetically, i.e. the channel walls must be air tight. Sealing between hard (rigid) mechanical surfaces is done with soft sealing gaskets that are usually made out of rubber or foam. A silicone / rubber material is recommended due to its sealed structure that does not allow air to pass through it. Foams / sponges are not recommended if they require heavy compression to be air tight. Relying on compression to make a sponge-like material air tight is not a reliable way to execute acoustic sealing.

In bottom port microphones, the seal between the microphone and the device circuit board is soldered. The sealing of top port microphones is usually more challenging than bottom port microphones because the sealing is done with gaskets on top of the microphone and the sealing area available on top of the component is often limited.

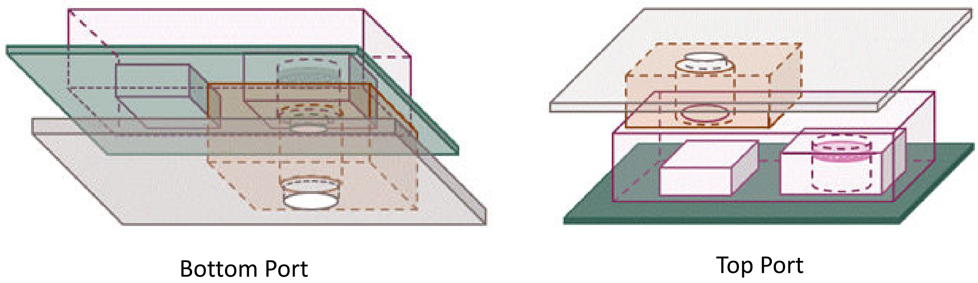

Figure 7 MEMS microphone acoustic sealing implementation

Poor sealing can cause several problems

- Variation in the sensitivity and frequency response of the microphone
  - Especially low frequencies may be significantly affected
  - This may be detrimental to DSP algorithm performance
- Noises inside the device may propagate to the microphone sensor
  - May lead to significant echo problems if the microphone picks up the outputs of the speakers or earpieces in the device
  - Sound from other components in the device
  - Handling noises

Note: Microphone sound channels must be sealed to optimize the quality and reliability of a microphone system. The way sealing is executed affects the acoustic properties of the microphone system

It is important to take all manufacturing tolerances as well as device deformations and aging into account when designing the sealing of an acoustic channel. Mechanical deformations can be caused by, for example, handling of the device or abuse such as the device being dropped. Aging can cause the sealing materials to become less compliant. Also, device mechanics may change their shape and lose their rigidity because of aging.

The sealing element must be able to handle mechanical deformations of the device

- The element must be compliant and thick enough to seal the gap it is designed to seal even if the surrounding mechanics are deformed
  - Mechanical simulations should be used to determine the maximum gap the sealing element has to handle
- The gasket has to be thin and compliant enough not to induce excessive forces on the microphone package or the device mechanics
  - Otherwise the microphone performance or reliability could be affected or the device mechanics may deform
  - The forces applied by the sealing element on the surrounding rigid mechanics or the microphone can be reduced without compromising sealing reliability by adding ribs to the element surfaces that are in contact with rigid mechanics (see ***Figure 8***)

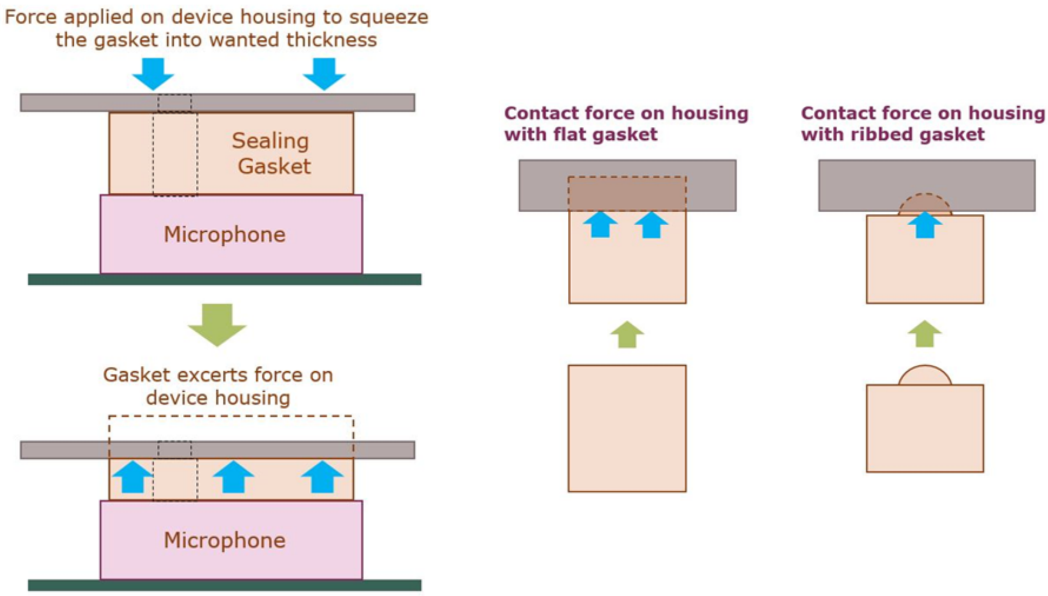

Figure 8 Sealing reliability

Due to manufacturing tolerances, aging and abuse, the sealing gasket location accuracies may be compromised. This can cause poor alignment of the hole in the gasket to the other holes it seals.

Poor alignment can cause sealing problems (see ***Figure 9***)

- The sound channel may leak
  - This can cause changes in sensitivity and frequency response, noise problems and echo problems
- The sound port may be blocked either completely or partially
  - This can cause changes in sensitivity and frequency response or even muting

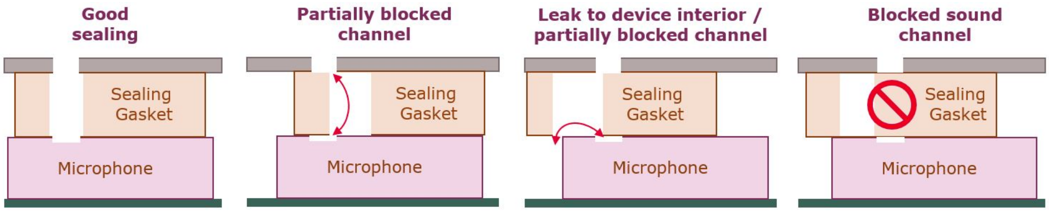

Figure 9 Sealing alignment

The size of the opening in the gasket or boot is a compromise. On one hand, it should be as wide as possible to reduce risk of blockage. On the other hand, to avoid Helmholtz resonators, it should not be bigger than the holes it connects. Another factor to be considered is whether or not the sealing element is visible when looking through the sound port on the device housing. A visible element compromises the visual quality of the device so the hole in the gasket should be big enough not to be seen from the outside of the device.

Care must be taken to ensure that the sound channel cannot fold or collapse under any circumstances. This is a risk especially in more complicated acoustic channels such as those that include bends within the sealing element or channels in which the acoustic path runs at an angle (not perfectly vertically (Z-direction) or horizontally (XY-plane)). The sealing material walls must be thick enough to maintain their shape. (See (3) in ***Figure 10***)

Molded rubber elements with turning channels in them may also have burrs at the bends. The sizes of the burrs may change drastically when the insert molding tools used for the manufacturing of the sealing element age. Therefore, quality control is important. (See (3) in ***Figure 10***)

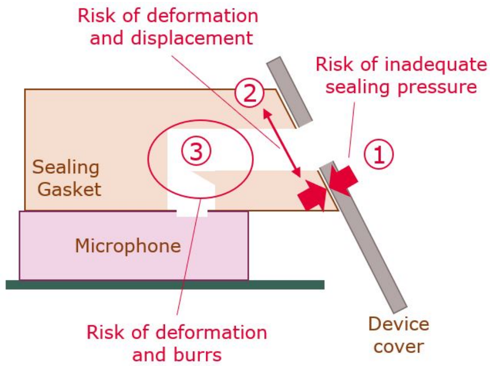

Figure 10 Vertical surface sealing alignment

The structures (surfaces) that are acoustically sealed with a gasket or a boot should be mechanically rigid

- Material thicknesses and shapes should be designed to have adequate rigidity
- Screw towers, snap hooks, braces, or other structure reinforcing features are recommended close to the sealed mechanics

The surfaces that are acoustically sealed with a gasket should also be smooth so that a good seal can be achieved between the surface and the gasket.

Vertical (Z-direction) surfaces may be difficult to seal due to the lack of adequate structural forces in the X/Y-plane (here, the X/Y plane is the plane perpendicular to the assembly direction of the device). In cases where the sealed surfaces are not exactly parallel, care must be taken that the sealing elements will stay in place and seal well. Mechanical support structures should be included into the design to prevent uncontrolled deformations or movement of the sealing element and to provide adequate surface pressure between the gasket and the device cover. (See (1) and (2) in ***Figure 10***.)

Note: Sealed surfaces must be designed to be stable and sealing elements suitably compliant (but still firm enough to hold their form) to ensure reliable sealing in all use cases throughout the lifetime of the device.

3.4 Sound port protection

The MEMS sensor and the ASIC of a microphone are more or less vulnerable semiconductor components that should be kept safe from contamination. There are solutions designed to protect microphones in applications where the whole device, including the microphones, has to endure compromised environmental conditions. The available solutions offer protection against dust and/or liquids. Dust protection can be partial or complete. Water protection can allow moisture or splash proofing or even making it safe to immerse the device in water. The protective elements are typically meshes, porous materials or membranes that can be built into the microphone package, included in a sealing gasket or built into the parts of the sound channel that are formed by the rigid device mechanics. Some of the meshes and membranes are reflowable so they can be assembled on / in the microphone before the device circuit board is reflowed. Including the mesh/membrane into the microphone package has the benefit of preventing contamination already during device production.

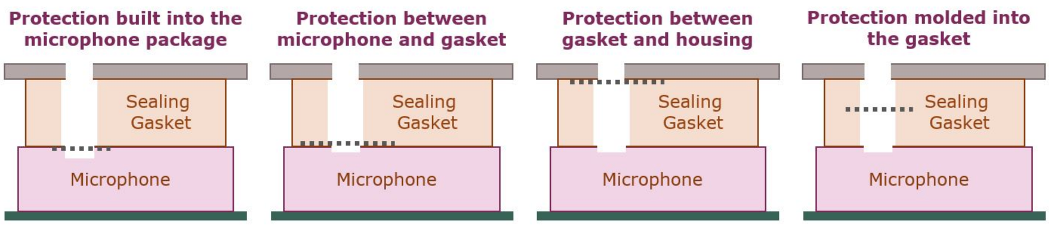

Figure 11 Sound port protection

The protection solutions usually affect acoustic performance. The more protection they offer, the more they tend to affect the performance. The parameters affected are typically sensitivity, frequency response and SNR. The effect on frequency response can be beneficial as a tool to dampen resonances and thus extend the usable frequency range of the microphone system. The SNR reduction caused by a protective mesh or membrane, depends on the material properties and size.

The acoustic resistance of the protective element (and thereby the effect on acoustic variables, such as frequency response, of the microphone implementation) is affected by many factors: the thickness of the mesh, sizes of openings, number of openings per unit area, IP rating, etc. For example, the bigger the openings are, the lower the acoustic resistance and the smaller the effect on frequency response are.

A protective mesh or membrane can also dampen pressure shocks that the microphone may be subjected to. This may help the microphone survive shocks that would otherwise cause damage. A mesh/membrane can also be conductive and grounded in order to provide protection from electrostatic discharges (ESD).

The protection levels of devices and microphone protection solutions are measured with an IP rating. IP stands for *International Protection Marking* and it is an IEC standard (60529). The IP code classifies the degree of protection against dust and water. The syntax for IP codes is IPxy, where x describes solid particle protection and y describes liquid ingress protection. For example, IP67 means that the device is ‘dust tight’ (completely protected) and is suitable for immersion in water less than 1m deep.

Note: *Environmental protection solutions usually affect the acoustic performance of microphones. The more protection, the bigger the effect. In some cases, this can be beneficial for acoustic performance.*

3.5 Microphone placement

The locations of microphones in a device should be acoustically optimized

- Microphones should be located close to the surface of the device to minimize sound port lengths
- Microphones should be placed close to the sound source, especially in devices that are held close to the sound source such as the user's mouth (smartphones, headsets, smart glasses, etc.)
  - *Note: Some noise cancellation systems require placing one of the microphones as far as possible from the source*
- Multi-microphone arrays set requirements on microphone placement that vary from algorithm to algorithm (see details in the ***Chapter 3.6*** section)
- For stereo recording, the *acoustic distance* between the microphones should be maximized
  - Acoustic distance is the distance between the two sound ports measured along the surface of the device
- The location of the sound port on the surface of the device can affect how the device housing affects the frequency response of the microphone(s)
  - For example, placement in a corner is typically better than placement in the middle of a flat area
- Accidental blocking of sound ports (by, for example, users' hands) must be prevented by design

Microphones should be placed away from noise sources when possible

- Electrical / electromagnetic noise: antennas (1), switching systems (2), power amplifiers (3)
  - For example, it is preferable to locate microphones and antennas on opposite sides of a circuit board
- Acoustical noise: speakers (4), earpieces, switchers (2), actuators (e.g. camera (5)), handling noise (7)
- Mechanical (structure-borne) noise: handling noise (7) or vibrating components in the device; keypads, UI buttons (such as a volume rocker (6)), vibration motors, camera actuators (5)

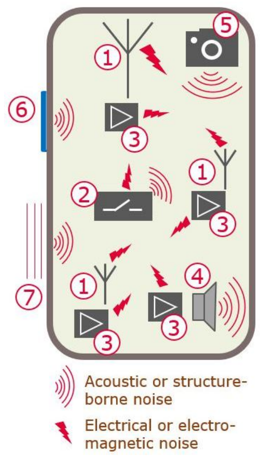

Figure 12 Smartphone

Microphones should be located away from mechanical stress sources or stress centers

- Push buttons and other user interface features where force is applied on the device
- High stress locations in the device mechanics that may cause deformations
  - A high stress point may appear, for example, in the middle of a large circuit board away from supporting structures such as screw towers
- The device circuit board and other mechanics should be properly supported close to microphones
- Temperature can also be a stress factor so microphones should be located away from heat sources (for example, power amplifiers)

3 Mechanical implementation

A variety of very different use cases set different requirements for the microphone system:

- Phone-on-ear speech
  - Approximate direction of the incoming sound (user's speech) is known
  - One microphone as close as possible to the mouth of the user, (possible) other microphones located based on the needs of the noise cancellation system used in the device
- Device in hand away from the head / mouth
  - Direction and distance of the incoming speech or other sounds are not known
- Teleconferencing
  - Device on table, several sound sources in different directions at different distances
- Digital assistant
  - Varying source direction and distance
- Video capturing
  - Sound of the objects in the video image in front of the camera
  - Possibly narrative speech from the person filming behind the camera

In many cases, the direction of the sound source in relation to the device is not known so the capturing system has to be versatile; see section ***Chapter 3.6***

Note: Microphones should be placed in a device in correct locations to optimize sound capturing performance (requirements depend on, for example, device, applications and algorithms), away from unwanted noise sources and away from stress sources.

3.6 Microphone arrays

The way a multi-microphone array is designed to work determines the correct locations for the microphones. For example, a microphone array in a speech controlled system can be linear (2 or more microphones in the same line side by side), circular (3 or more microphones in a circle) or in a 3-dimensional configuration.

Hand-held devices or wearables can use a single-microphone system, depending on the sound capturing requirements. Devices used in the proximity of the user but not necessarily in hand (for example, 1 – 2m distance) are likely to benefit from a 2-microphone system. For devices that need to capture sound / speech from further distances (or from arbitrary directions), an array of 3 or more microphones is recommended. The array should be accompanied by a noise cancellation system, blind source separation algorithm or other such capturing improvement method that uses multiple microphones to improve signal quality.

Typically, arrays with 3 or more microphones offer improved performance in cases in which the direction (angle) of the incoming speech is not known. A good example of a device like this is a smart assistant device (smart speaker). A 3-microphone array also enables speaker localization, but possibly only in the horizontal plane. For 3-dimensional localization and sound capturing, also the array may have to be 3-dimensional (not all microphones in the same plane).

Systems where the angle of the arriving speech is known, at least approximately, may be able to cope with linear 2-microphone arrays. This is the case for, for example, wall mounted devices where sounds arrive from the front of the device.

3.7 Handling noise

Handling noise can affect the perceived audio quality of a device significantly. It can originate, for example, in the hands of the user rubbing against a rough surface of the device while changing their grip, or the user using the push buttons or keypad of the device. Depending on microphone locations, handling noises can originate very close to the microphones and the captured noise level can be high.

Handling noise can be prevented by

- Making the device mechanics sturdy and rigid to prevent deformations and creaking while handled (1)
- Choosing a device surface finish that causes minimal noise when handled (2)
  - This can sometimes go against the wishes of industrial designers in charge of designing the appearance and feel of the device
- Using high quality push buttons and keypads (3) that don't rattle or make other noise, such as loud clicks
- Sealing the microphone sound channel properly (4)
  - This helps prevent handling noise propagation from the inside of the device to the microphone

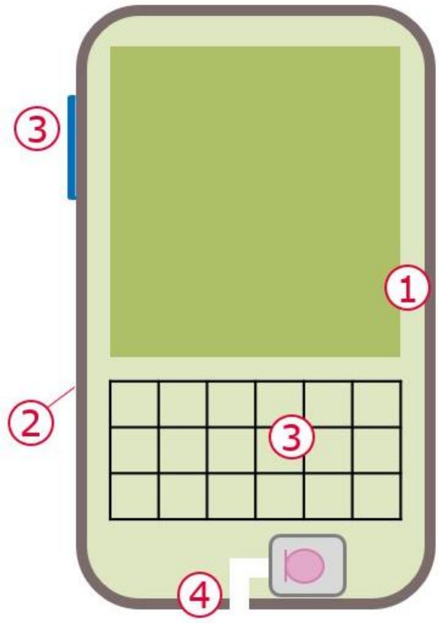

Figure 13 Handling noise prevention

3.8 Reliability

In addition to improving microphone operational stability and preventing handling noise, it is also important to design the device mechanics to protect the microphones from permanent damage. The forces at play when a device is, for example, dropped are very high and deformations are inevitable. The whiplash of the device mechanics after the initial impact can be more harmful than the original impact and deformation. The device mechanics around the microphone must be designed not to induce unbearable forces on the microphones or subject them to mechanical hits or bumps that may damage the components or their solder joints.

The exact mechanical shock risk mitigation method varies from one case to another. The mechanical designer and reliability test engineers in charge of the design should be made aware of the risks.

Note: Device mechanics around the microphone must be designed not to induce unbearable forces on the microphones or subject them to mechanical hits that may damage the components or their solder joints.

3.9 Reflow, pad layouts and stencils

The pad layouts on the device circuit board as well as solder masks / stencils for device production must be designed according to the guidelines and specifications given in microphone data sheets.

Following the right guidelines helps ensure that

- The amounts of solder paste on the microphone contact pads are correct
- The microphone solder adhesion to the circuit board is reliable
- The microphone does not tilt during reflow
- The acoustic seal rings on the bottoms of bottom port microphones are completely sealed
- There is no solder splashing into the port hole of a bottom port microphone during a high-speed pick&place process

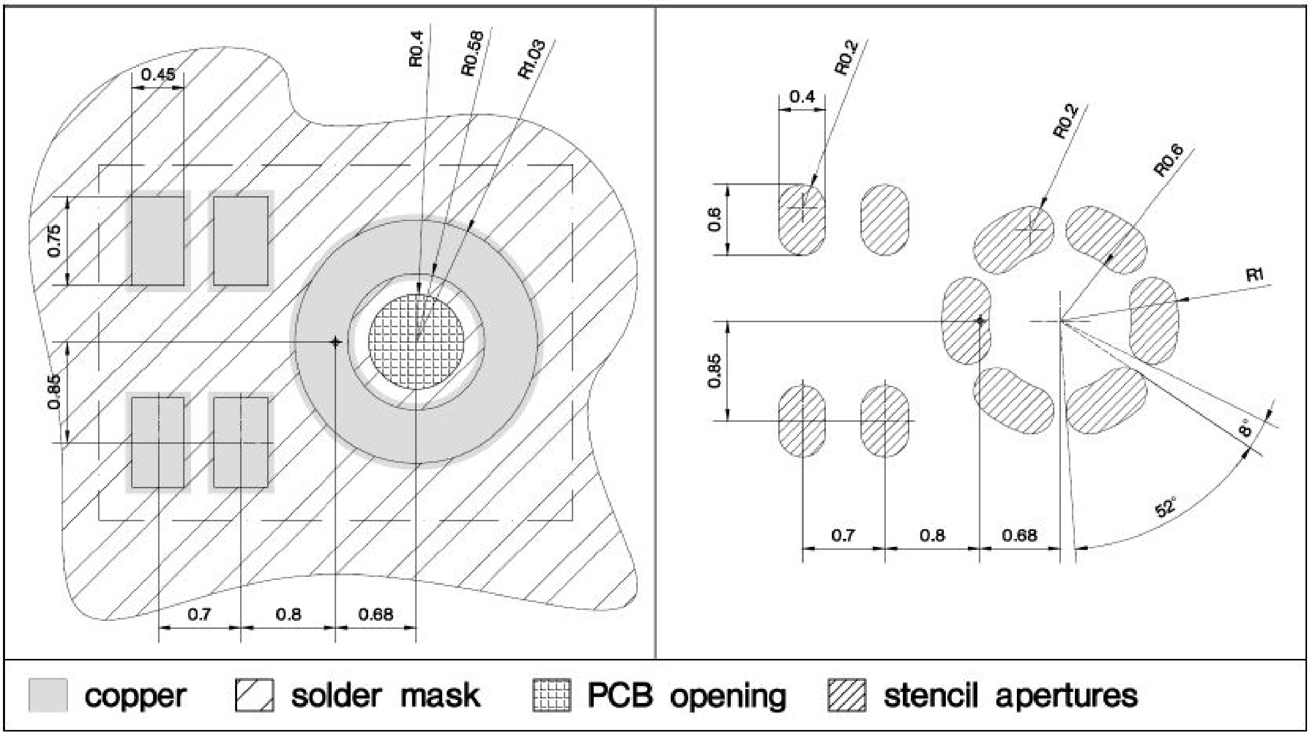

Figure 14 Infineon IM69D130 microphone footprint and stencil recommendation example

4 Acoustical and mechanical implementation – summary

The sound channel in a device is a key factor determining the performance of a microphone. It must be designed to minimize the effect of resonances. The acoustics and mechanics around the microphone must be stable to avoid short and long-term changes that could affect audio quality. Sturdy device mechanics and elimination of noise sources help prevent handling noises.

Good and reliable sealing is a critical enabler for high audio capturing quality. Sealing must work well in all use cases throughout the device lifetime. The device implementation must also provide the microphones with proper protection from environmental conditions such as dust and liquids as well as abuse such as impacts. Microphones must also be provided with a working environment free of mechanical stresses.

Microphones must be placed correctly in a device in relation to the sound sources. The requirements set by multi-microphone algorithms must be taken into account. The microphones must also be placed away from noise sources and stress factors.

The size of the implementation can be minimized by choosing the right microphone type for the device mechanics

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